



**REPORT
ON
MINOR IRRIGATION WORKS
(KERALA STATE)**

COMMITTEE ON PLAN PROJECTS

(Irrigation and Power Team)

New Delhi

July 1960

LETTER OF TRANSMITTAL

No. COPP/I & P/9/60
COMMITTEE ON PLAN PROJECTS
7, York Place,
New Delhi.
Dated the 29th July, 1960.

Dear Shri Pantji,

This report on Minor Irrigation Works in Kerala is the fourth in the series of studies carried out by the Minor Irrigation Team in various States. The Study of Minor Irrigation Works in Kerala was initiated by my predecessor Shri N.V. Gadgil.

I am glad to forward a copy of this Report to you and take this opportunity of thanking you for the close personal interest you have always taken in the Team's work.

With respects,

Yours sincerely,

A.N. KHOSLA

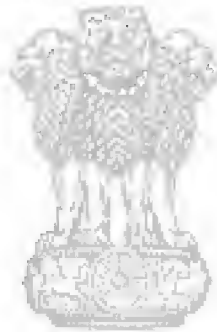
Shri Govind Ballabh Pant,
Minister for Home Affairs,
Government of India,
NEW DELHI.



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PREFACE

This is the *fourth Report in the series issued by the Minor Irrigation Team appointed by the Committee on Plan Projects for study and investigation of the Minor Irrigation Works in the States of Mysore, Madras, Andhra Pradesh, Kerala, Uttar Pradesh and Punjab. The Team visited the State of Kerala in May 1958 in accordance with the Memorandum No. COPP/(4)/9/58, dated the 26th March 1958, to study the scope of work and methods to be employed. The Terms of Reference were communicated to the Leader of the Team by the Committee on Plan Projects under Memorandum No. COPP/(4)/17/58, dated the 4th August 1958 (Appendix IV). The Team comprised :

Shri N.V. Gadgil,

Leader

**Shri M. Narasimhaiya,
Chief Engineer (Retd.),
Mysore.

Member

Shri Lal Singh,
Director of Agriculture (Retd.),
Punjab.

Member

Shri Mahavir Prasad,
Irrigation Adviser to the Government of
India, Ministry of Food and Agriculture.

Member Ex-Officio

Shri N.V. Gadgil relinquished the Leadership of the Team on 26th September 1959. Later, Dr. A.N. Khosla joined as the Leader of the Team.

Shri D.S. Borker, Secretary to the Consultative Committee, Irrigation and Power Projects, also worked as Secretary to the Minor Irrigation Team.

2. Shri Padmanabha Iyer, Chief Engineer, Irrigation, P.W.D., was associated with the studies of the Team. The work was considerably facilitated by his active co-operation. The Members of the Team had several discussions with the State Authorities and had a meeting in May 1958 with the Chief Minister and other concerned Ministers. Thereafter, the Team also visited and studied in detail a number of Minor Irrigation Projects of different kinds, in the districts of Trivandrum, Quilon, Kottayam, Alleppy, Ernakulam and Trichur.

3. The Team's main recommendations are:—

- (a) provision of irrigation and drainage works directed towards fuller utilisation of the available resources of water and land, including provision of small storage reservoirs to back up canal irrigation on minor schemes;
- (b) upward revision of water rates in accordance with the recommendations of Taxation Enquiry Commission; and

* First three Reports on Minor Irrigation Works in Mysore, Madras and Andhra Pradesh were issued in September 1959, November 1959 and May 1960 respectively.

** Ceased to be Member from 22nd February 1959 and hence the benefit of his advice was not available to the Team in the studies undertaken thereafter.

(ii)

(c) raising cash crops like sugarcane and garden crops on lift irrigation so as to render such schemes remunerative.

4. We take this opportunity to place on record our gratitude to Shri V.T. Krishnamachari, Deputy Chairman, Planning Commission for his active interest in the Team's work. Shri T.P. Kuttiammu, the then Chief Engineer, Irrigation in Kerala Government rendered valuable help during the Team's visits and field studies. We also wish to place on record the appreciation of the Team for the competent services rendered by the Secretary of the Team, Shri D.S. Borker and Shri S.G. Balekundry; Superintending Engineer attached to the Team.



CHAPTER I

GENERAL

Kerala comprises the Southern most part of Western Coast of India, between latitudes 8°N to 12°N. The Eastern boundry of the State generally terminates at the ridge point of the Western Ghats. The entire State is thus mostly on the wind-ward side of the Ghats in relation to the South-Western Monsoons. Consequently the rainfall in the State is very heavy and ranges from a minimum of about 60 inches to a maximum of 200 inches. From the Isohyetal Map of Kerala, facing page 2, the average rainfall in each District is deduced as under:—

| Sl. No. | District | Rainfall in (inches) | Sl. No. | District | Rainfall in (inches) |
|---------|-----------------|----------------------|---------|------------------|----------------------|
| 1 | Cannanore | 160 | 6 | Kottayam | 120 |
| 2 | Kozhikode | 120 | 7 | Alleppy | 80 |
| 3 | Palghat | 100 | 8 | Quilon | 120 |
| 4 | Trichur | 140 | 9 | Trivandrum | 80 |
| 5 | Ernakulam | 150 | | | |

2. Topographically the State can be divided into three regions each being a linear strip more or less parallel to the coastline. The Eastern-most region comprises the mountainous terrain of the Western Ghats at levels varying from 500 feet to 8,000 feet above sea level. This area is covered with dense forests and the only cultivated crops are mainly tea and cardamom. The middle region is an undulating country of laterite hillocks and narrow valleys. The hill slopes are cultivated with rubber, pepper, cocoanuts, arcanuts or other garden crops while the flat areas in the valleys are cultivated with paddy, bananas, sugarcane etc. The coastal region comprises the flat stretch coastal land around the back-waters and lagoons into which the several rivers discharge. Cocoanuts and paddy are grown in this region. The low lying lands here are subjected to inundation during floods and influx of salt water from the sea during the summer months.

3. The variety of crops that are grown in the varying features of the State are indicated in the following Table showing the cultivated area for crops like tea, coffee, rubber, etc.

| Sl. No. | Crop | Area (1000 acres) | Average yield per acre (lbs.) | Production in 1000 tons | Value (in Crores Rs.) |
|---------|---------------|-------------------|-------------------------------|-------------------------|-----------------------|
| (1) | (2) | (3) | (4) | (5) | (6) |
| 1 | Paddy | 1,954 | 1,557 | 1,358 | 41.4 |
| 2 | Pulses | 111 | 343 | 17 | 0.4 |
| 3 | Tapioca | 558 | 6,298 | 1,569 | 7.8 |

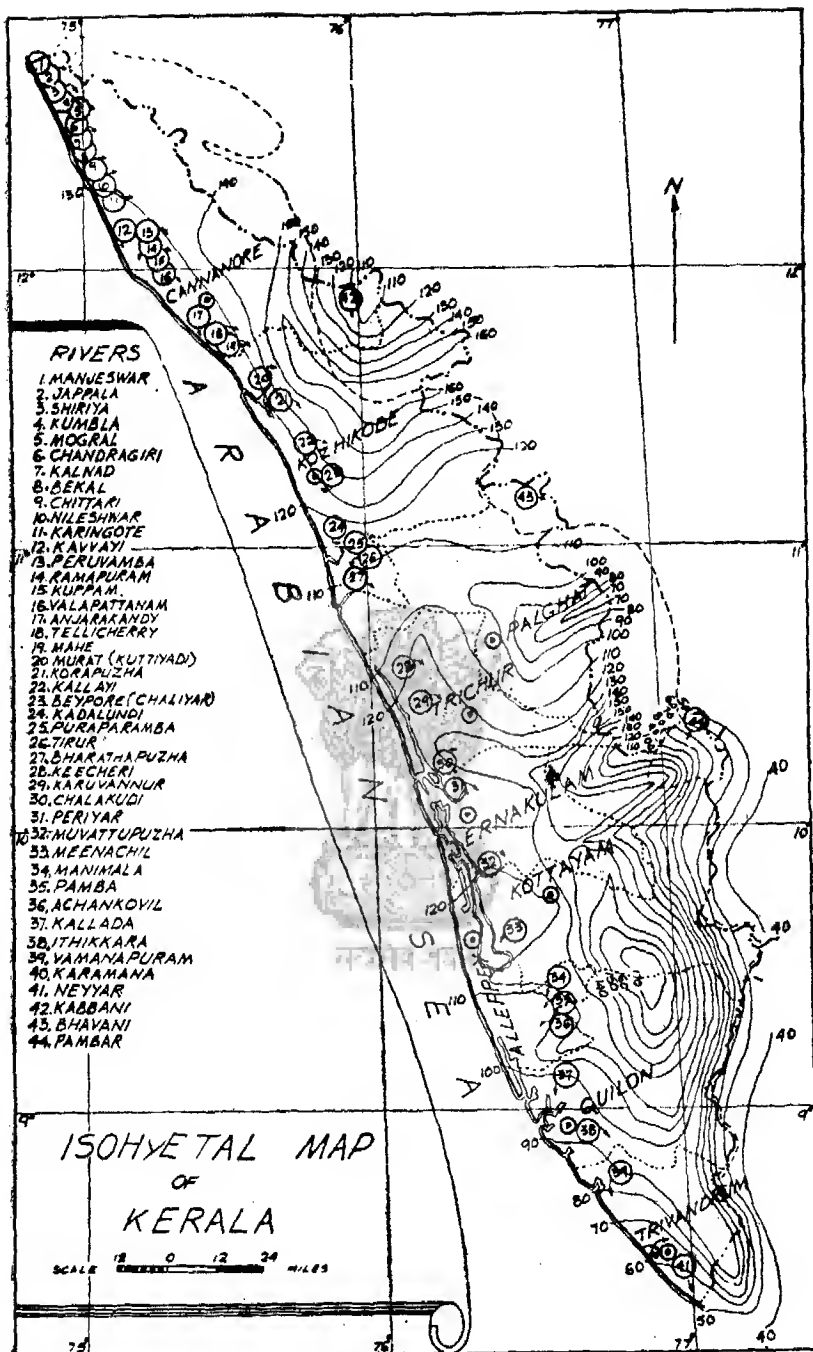
| (1) | (2) | (3) | (4) | (5) | (6) |
|---------------------------------|-------------------|-----------|-----------------|-------|-------|
| 4 | Bananas | 116 | 6,005 | 311 | 8.5 |
| 5 | Sugarcane | 18 | 40,693 | 327 | 1.3 |
| 6 | Pepper | 214 | 283 | 27 | 7.1 |
| 7 | Ginger | 26 | 1,120 | 13 | 2.8 |
| 8 | Cardamom | 69 | 32 | 1 | 3.0 |
| 9 | Arecanut | 144 | 45,000 Nuts. | 648** | 9.9 |
| 10 | Cashewnut | 93 | 1,349 | 56 | 3.8 |
| 11 | Cocoanut | 1,107 | 2,800 Nuts. | 310** | 49.4 |
| 12 | Groundnut | 33 | 950 | 14 | 0.8 |
| 13 | Rubber | 160 | 294 | 21 | 6.8 |
| 14 | Coffee | 41 | 164 | 3 | 1.6 |
| 15 | Tea | 99 | 679 | 30 | 14.2 |
| TOTAL .. | | 47,43,000 | — | — | 158.8 |
| Other Minor Crops and Fruits .. | | | | | 21.2 |
| | | | GRAND TOTAL .. | | 180.0 |

4. The net income from an acre of cultivation of these crops varies greatly. While from an acre of paddy the net income is estimated at Rs. 95 the income from cocoanut and pepper is Rs. 300 each, arecanut Rs. 900, ginger Rs. 400, coffee Rs. 350, turmeric and cardamom Rs. 450 each, cashewnut Rs. 200 and banana Rs. 400. The State has no less than 500 large plantations, apart from hundreds of smaller ones. Of these plantations, tea finds the most important place. Total production of 30,000 tons of tea is valued at Rs. 14.2 crores. Tea cultivation alone is valued at about 7.9 per cent of the total agricultural production. In rubber, Kerala holds a monopoly in the country. Likewise, cardamom is another important crop largely exported to foreign markets. *Cashewnut cultivation is also coming into vogue as it is a hardy drought resistant tree and can be grown even in relatively poor soils. Because of the favourable conditions for cashewnut production in Kerala increasing area need be cultivated and the per-tree production be increased by the adoption of suitable cultural, manurial and plant protection measures so that the production is steadily maximised thereby gradually diminishing the import of cashewnuts from Africa.

5. The State has an area of nearly 15,000 square miles or 96 lakh acres and population in 1951 was 135.5 lakhs giving a density of 904 persons per square

*If cashew-nut is used for purposes of afforesting the steep hill slopes as is being done in Andhra Pradesh, using a spreading variety, it will provide an excellent canopy and prevent soil erosion caused by heavy rainfall in the hilly areas.

**In crores of Nuts.



mile. Population in 1956 was estimated at about 150 lakhs. This would average to a higher population density of 1,000 persons per square mile. The agricultural population accounts for 54 per cent of the total population. The livestock population in 1956 was 41.58 lakhs besides 67.95 lakh poultry birds. Per capita land in Kerala is only about one-third of an acre as against three-fourths of an acre for the country as a whole. The cultivated area of about five million acres is thus expected to support about 15 million people and about four million cattle, *i.e.*, a ten-acre-field is expected to support 30 men and eight cattle whereas the area required for proper maintenance of cattle alone is estimated at one acre per battle. Because of high density of population the prices for land are high, ranging from Rs. 2,000 to 8,000 per acre.

6. Water resources, however, are bountiful in this State. There are about 44 streams including three East flowing tributaries of Cauvery. The average annual run-off from these rivers as given in Appendix I, is of the order of about 2500 T.M.C. Ft. which is about five per cent of the all India's total. In addition to the abundant water potential, the steep slopes of the rivers provide a hydro-power potential of about two million K.W. (at 60 per cent load factor).



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CHAPTER II

AGRICULTURAL ASPECTS

The cultivated area under the essential food crops of paddy, pulses and tapioca is 2.62 million acres, which is only about a fifth of an acre for every person. This is the all India lowest figure and mainly accounts for large annual food deficit. The production of major food crops mainly, rice for 1955-56 was only about 9.4 lakh tons and about 0.7 lakh tons of rice had to be imported from the neighbouring States.

2. In the Master Plan prepared by the State Authorities in 1958, the annual demand for food grains at sixteen ounces per capita for 13.5 million population is placed at 2.2 million tons. To wipe off the deficit, it is planned therein to provide irrigation facilities to about 1.4 million acres of paddy.

3. The Team was, however, struck by the following outstanding agricultural features in Kerala:—

- (a) non-paddy crops per acre of land, bring to the cultivator far greater returns—as much as 600 per cent higher than paddy crop;
- (b) non-paddy crops bring substantial amount of much needed foreign exchange and there is immense scope for further increase in their development; and
- (c) whereas the standard of cultivation in case of paddy crop, as judged from per acre yield, is already satisfactory and there is not much scope for improvement except at heavy cost, the standard of cultivation in case of non-paddy crops is relatively low, pointing to the need and scope for improvement. The Team was given to understand that it was possible to increase the average yield of cocoanut trees by even 300 per cent, only if necessary attention in the form of adequate irrigation and manuring and control of pests etc., could be given. Cocoanut accounts for Rs. 49.4 crores out of the total value of agricultural output of Rs. 180 crores. Any increase in the yield of cocoanut trees would have very substantial favourable impact on the finances of the State and the economic prosperity of the peasantry. The same, more or less, applies to other plantation crops. On the other hand, it is apprehended that if the present low standard of cultivation of the these crops is allowed to continue much longer, they may fail to compete in quality and price in foreign markets, to the detriment of not only the cultivating community of Kerala but of the State and the country at large.

4. The Team was convinced that there is ample scope for improvement in standard of cultivation of plantation and some crops other than paddy. *The average yield of rice for the year 1956-57 was 1025 lbs. though the average for the country as a whole was only 806 lbs. For the cultivation of non-paddy crops and fruit trees there appears to be a tremendous scope for development on the lines of what has been achieved for paddy. For instance, the production

*From "Estimate of Area and Production of Principal Crops in India, 1956-57, Vol. I," issued by Economics and Statistical Adviser, Ministry of Food & Agriculture, Government of India.

of latex in rubber plantation in Kerala is only about one-third of that in Malaya. In regard to coffee, the average per acre yield of coffee is only about one-half of the World, the area under coffee in our country being about two per cent and production only one per cent of that of the World; average yield of coffee is only 1.96 cwts. per acre and this is inclusive of the high yielding plantations. There are thousands of small coffee planters whose average yield is very much less, even as low as three quarters of a cwt. But some progressive coffee growers are producing as much as eight cwts. per acre or even more, thereby demonstrating that there is nothing inherently wrong with the climate and soil and there is immense scope for development. Coffee is already meeting very stiff competition in foreign markets both in price and quality. Likewise, pepper, which has so far been a good dollar earner, is subjected to a severe competition from some of the East Asian countries.

5. Coconut trees, apart from being poorly nourished and consequently yielding poor returns, are also suffering severely from the ravages of insect pests and diseases. Menon and Pandalai (1951) had reported that the annual loss caused by the leaf and root wilt diseases of coconuts in Travancore-Cochin area of the Kerala State exceeded Rupees one crore. According to a survey on the incidence of disease conducted over an area of 31.49 acres growing 1,555 trees, as many as 78.5 per cent of the trees were found affected by various diseases, e.g., wilt, tapering stem, yellowing of outer leaves, general chlorosis etc. The former Director of Agriculture, Kerala, in his report states—"Coconut plantations have undergone serious deterioration particularly in Travancore-Cochin and several pests and diseases have infected the trees. They have spread to an area of 7,000 square miles, affecting eighty lakhs of trees reducing their yield by 50 per cent".

6. There is very great justification on economic grounds for not laying excessive emphasis on paddy cultivation in States, like Kerala, blessed with special climate suitable for certain fruits and plantation crops including coconut, arecanut, spices, etc., which other States are not fortunate enough to grow. Even in regard to food crops, water potentials being created, can be more profitably utilised in production of food crops other than paddy as a given quantity of water can mature several times more area of non-paddy crops. The State's deficiency in paddy, if any, should, in the opinion of the Team, be made good from other parts of the country, which have reserve stocks. The water, land and human resources should be put to uses which are most productive and profitable to the cultivators of the State and the Nation as a whole. Plantation crops like coconuts, arecanut, spices, tea, coffee and such fruits which cannot be grown elsewhere deserve special attention and so also fish culture etc., and the canning industry.

7. Canada with a slightly larger population than that of Kerala realises an annual commercial catch of about two billion pounds of which nearly 65 per cent is exported. In 1956 fish products worth 133 million dollars out of a total produce of 197.6 million dollars were exported. The Norwegian Team exploring deep-sea fish resources have found the Indian Ocean nearer to Malabar Coast to be one of the richest fish stores in the World, yet only about five miles width along the coast is exploited. With the expansion of the demand for fish in the country, fish industry can be developed on a larger scale provided adequate attention is given to it by the State Authorities particularly development of canned-fish production.

8. Similarly there is large scope for canning industry being organised for processing of pine-apple. In several parts of the State conditions are very

favourable for pine-apple plantation. At Allingal near Mamon river the Team came across a small pine-apple plantation bearing fruits weighing 6-8 lbs. each. Reckoning at 4,000 plants on an acre, the production ranging between five to ten tons of fruits per acre should be possible. Even a yield of five tons per acre can bring very handsome returns to the cultivator. Larger areas can be put under pine-apple only if arrangements can be made for canning the fruit. There appears to be ample scope for canning the pine-apple juice as well. This industry can bring good returns as has been the experience in Australia and in the Hawaii Islands.

9. Alongside the schemes undertaken for developing irrigation in the State, there is need for concerted attempts being made at arresting the soil erosion noticed by the Team in several areas. The soil cover of two-to-four feet above the rock which is now making it possible to grow good crops and sustain vegetation, would in due course of time be washed away if immediate precautions are not taken in advance, to conserve the shallow depth of soil. The State has heavy rainfall and as most of the land has steep slopes, special measures for soil conservation need be planned.



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CHAPTER III

IRRIGATION PLANNING

An idea of the progress on irrigation made in the State can be had from the following figures:—

| | | <i>Area irrigated in Acres</i> | | | | | |
|------|-------|--------------------------------|----------------|--------|--------|---------------|---------|
| Year | | Govt. canals | Private canals | Tanks | Wells | Other sources | Total |
| 1951 | | 317,674 | 68,074 | 72,286 | 25,726 | 259,628 | 743,388 |
| 1956 | | 327,671 | 68,113 | 77,400 | 28,499 | 309,380 | 811,063 |

2. Even though the total annual rainfall is high, the distribution thereof in various months is not uniform, and deficiency is felt at the beginning of, in between and at the close of the Monsoons for raising two crops of paddy. Irrigation is planned for meeting this deficiency.

3. According to the Statement (on page 8) showing progress of minor irrigation during First and Second Five Year Plans and proposals for the Third Five Year Plan, the minor irrigation proposals in Third Plan are summarised below:—

| Sl. No. | Item | Third Plan | | |
|---------|------------------------|-------------------|--------------------------|-----------------|
| | | Cost (Rs. crores) | Net Area (Million acres) | Cost/Acre (Rs.) |
| 1. | Minor Irrigation | 5.7 | 0.114 | 500 |
| 2. | Lift Irrigation | 2.3 | 0.092 | 250 |
| TOTAL | | 8.0 | 0.206 | |

4. It was explained to the Team that the capital cost of the schemes shows an upward trend from what was provided in the earlier Plans partly on account of general increase in costs and partly on account of the easier and better sites having been developed earlier.

Statement giving Progress of Minor Irrigation during First and Second Five Year Plans and Proposals for the Third Five Year Plan

| Sl. No. | Classification | Third Five Year Plan, Medium, Minor and Lift Irrigation, Comparative Benefits of Second and Third Plans. | | | | | | |
|----------|--------------------|--|---------------------------------|---------------------------------|-------------------------------|---------------|---------------------------------|--------------------------|
| | | First Five Year Plan in lakhs | Second Five Year Plan Provision | | | | Third Five Year Plan | |
| | | | Cost in lakhs | Gross area in thousand acres ** | Addl. food production in tons | Cost in lakhs | Gross area in thousand acres ** | Addl. production in tons |
| 1 | Medium Irrigation. | 104.84 | 133.68 | 182.00 | 29,300 | 340.00 | 136.00 | 45,300 |
| 2 | Minor Irrigation. | — | 72.00 | 84.00 | 10,500 | 230.00 | 92.00 | 23,000 |
| 3 | Lift Irrigation .. | 28.57 | 28.63 | 38.00 | 4,750 | 230.00 | 184.00 | 46,000 |
| TOTAL .. | | 133.41 | 234.31 | 304.00 | 44,550 | 800.00 | 412.00 | 114,300 |

**Received from C.E. (Irrigation), P.W.D., Kerala State. It has been clarified that Gross Area is twice the net area, since two additional crops are grown.



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5. The actual progress of expenditure during First Plan, anticipations for Second Plan and proposals for Third Plan are Rs. 133, Rs. 2.34 and Rs. 8 crores respectively.

6. The Statements 1(A) and (B) covering basins of three rivers, viz., (i) Meenachil, (ii) Manimala and (iii) Atchencoil, reveal that about two-thirds of the run-off (rainfall) is obtained in the Viruppu season and one-third in Mundakan season and practically nil in the third crop season. As the minor irrigation schemes are mostly meant for supplementing the rainfall during the first and second paddy seasons, even arrangement of small storages on these schemes will ensure irrigation benefit to large areas.

7. The Master Plan for irrigation in "Water Resources of Kerala", envisages utilisation of run-offs for irrigation as follows:—

| | inches |
|-----------------------------------|------------|
| (i) Viruppu (First crop paddy) | 12 |
| (ii) Mundakan (Second crop paddy) | 42 |
| (iii) Third crop paddy | 60 |
| TOTAL | 114 |

8. Considering the rainfall in Meenachil Basin for the year 1955 as representative, an approximate distribution of 54 inches of irrigation water for two crops (12 inches for Viruppu and 42 inches for Mundakan) can be taken as follows:—

| Season | VIRUPPU | | | | | MUNDAKAN | | | | | Total |
|------------------|---------|------|------|------|------|----------|------|------|------|------|-------|
| Months | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Jan. | |
| Rainfall (in.) | 6.4 | 19.6 | 31.6 | 15.2 | 5.2 | 16.4 | 10.7 | 9.4 | 0.3 | 0.4 | 115.2 |
| Irrigation (in.) | 6 | — | — | — | 6 | — | 6 | 9 | 15 | 12 | 54 |

The requirements of storage are worked out in Statement II, on the basis of above distribution of irrigation requirement, from which it will be seen that the area benefited per M.C.Ft. of live storage is as high as 20 to 40 acres. This means 40 to 80 acres of gross crop yields accrue per M.C.Ft. of storage. Therefore, the Team recommends provision of necessary storages to back up the canal irrigation on minor schemes, unless such storages are available from major reservoirs.

9. The conditions in Kerala's 'netherlands' are such that the lands are under flood waters during both the first and second crop seasons and it is only possible to raise 'Punja' paddy in the third crop season—December to May. Supplies for such paddy would best be had from the tail flows of hydro-electric projects, failing which special storages may be necessary.

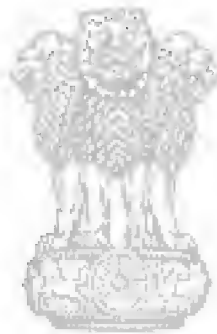
10. Shri D.V. Rao, in his Report on "Utilisation of Irrigation Potential" in Kerala State submitted to the Ministry of Irrigation, has suggested that the Agricultural Department should undertake measures to:—

(a) stop the practice of allowing irrigation water to continuously flow from field to field and get wasted—the Department of Agriculture

is called upon to find out as to why exactly the cultivators have to resort to this practice and provide remedies;

- (b) introduce the transplantation system of sowing the first paddy instead of the present practice of broad-casting—the yield per acre would thereby increase by about 300 lbs. , and
- (c) establish Demonstration and Experimental Farms to popularise use of manures.

The Team recommends speedy steps to implement wherever possible the above suggestions which will go a long way in reducing the cost of projects and in increasing the irrigation benefits resulting ultimately in stepping up the gross yields. Switching over to transplantation system for the first paddy crop needs stored water and therefore, it is rather difficult. But to the extent natural flows or tail-waters flows from hydel works are available, these should be put to maximum use.



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STATEMENT I-A

Rainfall Statistics in inches for (i) Meenachil, (ii) Manimala and (iii) Atchencoil River Basins.

| Month | Meenachil River Basin (a) | | | Manimala River Basin (b) | | | Atchencoil River Basin (c) | | |
|------------|------------------------------|------|-------|-----------------------------|-------|-------|-------------------------------|-------|-------|
| | 1953 | 1954 | 1955 | 1953 | 1954 | 1955 | 1953 | 1954 | 1955 |
| January .. | 0.2 | 1.7 | 0.4 | 1.9 | 1.7 | 0.0 | 1.1 | 2.4 | 0.1 |
| February | 1.1 | 0.0 | 0.6 | 1.6 | 1.8 | 0.8 | 1.4 | 0.0 | 0.1 |
| March .. | 2.2 | 5.2 | 2.6 | 2.8 | 10.2 | 3.2 | 1.1 | 6.4 | 1.3 |
| April .. | 8.1 | 4.6 | 6.4 | 1.1 | 7.9 | 8.5 | 9.8 | 13.4 | 7.4 |
| May — | 2.6 | 7.9 | 19.6 | 1.1 | 12.7 | 22.1 | 5.3 | 7.8 | 18.4 |
| June .. | 11.7 | 19.6 | 31.6 | 9.5 | 20.5 | 28.6 | 12.2 | 24.3 | 28.6 |
| July .. | 34.7 | 15.4 | 15.2 | 28.7 | 13.2 | 11.5 | 33.2 | 20.7 | 10.6 |
| August .. | 9.7 | 11.4 | 5.2 | 7.8 | 13.9 | 4.9 | 14.4 | 14.2 | 5.7 |
| September | 3.5 | 5.0 | 16.4 | 6.8 | 6.2 | 16.8 | 5.7 | 7.7 | 13.6 |
| October | 17.5 | 14.2 | 10.7 | 26.5 | 11.8 | 10.6 | 16.9 | 17.7 | 12.0 |
| November | 2.8 | 3.7 | 9.4 | 4.5 | 1.2 | 12.4 | 4.7 | 2.5 | 9.2 |
| December | 0.0 | 3.0 | 0.3 | 0.3 | 7.0 | 0.2 | 0.5 | 2.6 | 1.9 |
| TOTAL .. | 94.1 | 91.7 | 118.4 | 92.6 | 108.1 | 119.6 | 106.3 | 119.7 | 108.9 |

- (a) From Statement—XXXVI—2,3&4
 (b) From Statement—XXXVII—2,3&4 } in 'Water Resources of Kerala'.
 (c) From Statement—XXXIX—2,3&4 }

STATEMENT I-B

Percentage Run-off in different Seasons

(All quantities in T.M.C.Ft.)

| | May-Aug (Viruppu) | Sept-Dec. (Munda- kan) | Jan-April (3rd Crop) | Total (May- April) |
|----------------------------|----------------------|------------------------------|----------------------------|--------------------------|
| <i>A. River Meenachil</i> | (a) | | | |
| 1953 | 37.3 | 22.6 | 0.6 | 60.5 |
| 1954 | 41.4 | 17.3 | 0.2 | 58.9 |
| 1953 and 54 | 78.7 | 39.9 | 0.8 | 119.4 |
| Percentage of Total .. | 65% | 33.3% | 0.7% | 100.0% |
| <i>B. River Atchencoil</i> | (b) | | | |
| 1954 | 31.0 | 19.4 | 1.6 | 52.0 |
| 1955 | 33.5 | 21.3 | 0.9 | 55.7 |
| 1957 | 55.2 | 12.3 | 0.4 | 67.9 |
| 1953-55 and 57 .. | 119.7 | 53.0 | 2.9 | 175.6 |
| Percentage of Total. | 68.1% | 30.2% | 1.7% | 100.0% |
| <i>C. River Karamana</i> | (c) | | | |
| 1957 | 11.9 | 8.5 | 1.0 | 21.4 |
| Percentage of Total.. | 56.5% | 39.8% | 4.7% | 100.0% |

Explanations :

(a) From Table XXXVI—2&3 of "Water Resources of Kerala".

(b) From Table XXXIX—3,4&6 of "Water Resources of Kerala".

(c) From Table XLIII—3 of "Water Resources of Kerala".

STATEMENT II

*Live Storage required for irrigation First and Second crop paddy in (1) Meenachil,
(2) Atchencoil and (3) Karamana River Basins*
(All figures in T.M.C.Ft.)

| Period | Irrigation water in inches | (1) Meenachil Basin Ayacut-78,200 Acres (a) | | | (2) Atchencoil Basin Ayacut-29,400 Acres (b) | | | (3) Karamana Basin Ayacut-19,800 Acres (c) | | |
|---------------------------------|----------------------------|---|--------|---------|--|--------|---------|--|--------|---------|
| | | Irri- | Run- | Live | Irri- | Run- | Live | Irri- | Run- | Live |
| | | gation | off | storage | gation | off | storage | gation | off | storage |
| | | water | in the | neces- | water | in the | neces- | water | in the | neces- |
| | | | river | sary | | river | sary | | river | sary |
| April .. | 6 | 1.7 | 0.6 | 1.1 | 0.7 | 0.5 | 0.2 | 0.5 | 0.8 | — |
| May .. | — | — | 14.0 | — | — | 9.3 | — | — | 2.3 | — |
| June .. | — | — | 34.6 | — | — | 20.5 | — | — | 8.5 | — |
| July .. | — | — | 18.1 | — | — | 12.1 | — | — | 7.7 | — |
| August .. | 6 | 1.7 | 73.2 | — | 0.7 | 4.0 | — | 0.5 | 2.6 | — |
| September | — | — | 12.0 | — | — | 4.2 | — | — | 2.1 | — |
| October | 6 | 1.7 | 17.6 | — | 0.7 | 10.8 | — | 0.5 | 5.4 | — |
| November | 9 | 2.6 | 2.7 | — | 1.0 | 9.7 | — | 0.7 | 5.7 | — |
| December | 15 | 4.2 | 11.3 | — | 1.7 | 4.4 | — | 1.1 | 1.9 | — |
| January .. | 12 | 3.4 | 0.3 | 3.1 | 1.3 | 0.5 | 0.8 | 0.7 | 0.2 | 0.5 |
| TOTAL .. | 54 | | | 4.2 | | | 1.0 | | | 0.5 |
| Net acreage/M.C.Ft. Storage. | | | | 19 | | | 29 | | | 40 |

- (a) The catchment at Neelamangalam gauge site is 321 square miles and the total catchment is 456 square miles. Therefore the run off is taken at 456/321 times that in Statement XXXVI—4, in "Water Resources of Kerala".
- (b) The catchment at Padalam gauge site is 327 square miles and the total catchment is 446 square miles. Therefore the run off is taken at 446/327 times that in Statement XXXIX—4, in "Water Resources of Kerala".
- (c) The catchment at Kundamana Kadavu gauge site is 140 square miles and the total catchment is 250 square miles. Therefore the run off is taken at 250/140 times that in Statement XLIII—3, in "Water Resources of Kerala".

CHAPTER IV

TYPES AND DESIGN OF MINOR IRRIGATION WORKS

The various types of minor irrigation works, as found in Kerala are :—

- (i) Spring-fed Tanks ;
- (ii) Diversion weirs with channels ;
- (iii) Lift Irrigation Works ;
- (iv) Salinity Control Works ;
- (v) Drainage Schemes ;
- and (vi) Surface Reservoirs.

2. The spring-fed tanks are perhaps the oldest type of irrigation works found in Kerala. They consist of large ponds excavated beneath ground-water level so as to tap the natural springs at the upper end. The water is let down at the lower end and fed to paddy fields, during the times when the rains fail. Such tanks are in reality open wells looking like tanks because of their largeness, shallowness and presence of canal sluices at the lower ends. Many tanks lie across natural drainage valleys, in which case the storm flow is diverted through a side drain skirting the tanks. To avoid breaching of tanks by storms, sometimes a part of storm flow above a certain level is admitted into the tanks from upper end and allowed to escape at lower end through a "waste-weir". Incidentally this prevents the rolling silt from entering the Tank.

There are many such old tanks in the State. As a complete list of all such tanks for the whole State is not available, the Team recommends preparation of an up-to-date list.

Possibility of having such tanks is considerable in Kerala because, (a) due to heavy Monsoons, the sub-soil water level is not far from the surface, (b) deep and porous soil holds a good deal of moisture, (c) rolling nature of ground in the mid-lands makes it easy for tapping the spring water through sluices at the lower end of the Tanks.

As these tanks are exposed, (1) they are likely to be silted up due to silt carried by storm water or even winds, (2) they are likely to be breached by storm waters, thus needing breach-closing, (3) a good deal of the previous spring water gets lost due to evaporation from the large exposed surface, (4) they are likely to be contaminated—a factor to be seriously considered since the tanks are also used as sources of drinking water supply and (5) a large area is occupied by such tanks. In order to obviate all these difficulties in future, the Team suggests resorting to underground tapping of the springs by means of open jointed pipe-drains placed within a reverse filter, cutting across the springs acting as a "percolation gallery", *in preference to the traditional tanks. The water can be tapped through the pipe-line with a control valve at the lower end.

*A method similar to this is employed in Persia since time immemorial. Some of the town water supply works executed in the Deccan by the former rulers on this pattern, are still working.

The Team would like to recommend that some such "filter taps" may be installed by the P.W.D. as an experimental measure in order to demonstrate the feasibility and desirability of such works to the public who would then go in for more. Also filter arms may be provided to the existing tanks to augment their water supplies, wherever feasible and necessary.

3. Diversion weirs with channels are feasible on a large scale, as the Kerala rivers carry a good flow from May to February, due to the too heavy Monsoons and deep soil mantle. Many such old works exist in the State and many more are planned. Also, the waters from the hydro projects, now planned in the mountains, would be diverted for irrigating the coastal plains by means of such schemes. The benefits of diversion channels, if backed up by storages would enhance considerably.

Since most of the river berms are occupied by paddy fields, any increase in the flood levels due to afflux above diversion weirs is resisted by the people whose fields get submerged. Therefore, in a majority of cases, recourse is taken to providing weirs with control gates. This increases the cost of the works generally but it is inevitable.

In some cases (such as the Killiyar Project near Trivandrum) where the gate structures were ordered with Tungabhadra workshop, supply of such gates was delayed by about a couple of years or more, thus holding up the whole work. As Tungabhadra workshop cannot cope with orders from all over the country, it is recommended that the State Authorities may organise local workshops to manufacture the gates and other control equipment for all such works which are required in large numbers.

4. The topographical and other features in the State are eminently suitable for development of lift irrigation. The nature of the country is predominantly undulating with alternating hills and valleys with the result that it is very seldom that vast contiguous stretches of cultivable land are available in the mid-land portions of the river basins. On the other hand, there are a large number of small blocks located on the fringe of the river and spread all over the State. These blocks of land cannot be commanded by flow irrigation schemes because of the intervening low levels. Lift Irrigation from adjoining rivers or streams, however, provides a ready answer for cultivation of these tracts.

5. Apart from favourable topographical features for lift irrigation, Kerala has no shortage of hydro-electric power potential, which can be cheaply available for lift irrigation purposes. The pumping lift involved is also not of a high order. The Team, therefore, recommends implementation of an extended programme of lift irrigation, even though the operational cost of those schemes is higher. The extra operational cost could be obviated by more careful initial planning of the schemes and securing utmost economy in the use of water. The peculiar configuration of the irrigation tracts suggests installation of small pumps as far as possible. This would also dispense with the construction of larger length of field channels.

It would be desirable that the pump sets for installation are selected as carefully as possible with a view to rendering most optimum performance under the particular condition of discharge and lift involved. The

requirement is likely to be mostly for lifting large quantities of water over small heads. For these conditions in many cases mixed flow or axial flow type of pumps might be more satisfactory than centrifugal pumps. In the opinion of the Team, careful selection and design of the pump set would go a long way in reducing the operation cost of the pump.

The Team recommends that wherever feasible piped conduits or overhead ducts supported on trestles might be preferred to open channels. The manufacture of particularly cheap pipes, specially for the purpose, with minimum of reinforcement and cement might also be considered.

6. There exist, in Kerala State, large areas of paddy fields bordering the numerous lagoons, estuaries and back waters that lie in the coastal region. Most of these lands are well below mean sea level. Consequently much of this land is flooded by the fresh water brought over by the rivers in the Monsoon season and is subsequently inundated by salt water when the river flow dwindles down. There is great need for construction of suitable projects that would act as salt water barriers and prevent the in-rush of salt into the paddy fields grown extensively in these areas. Such works will have a high Grow-More-Food value.

7. In a large number of low-lying tracts in the State flooded by fresh water during the Monsoon season, it becomes almost impossible to grow the first crop of paddy. However, the expeditious disposal of flood waters makes these areas indispensable for growing the second crop and particularly the third crop of paddy. The schemes for de-watering these areas should, therefore, form an important item under the Minor Irrigation Programme of the State.

8. Surface Reservoirs are comparatively new-comers to the State. The design practices followed are generally on the pattern followed in the (old) Madras State. The Team has to observe as follows :

(a) Spillway capacities provided in the three reservoir projects are as under :—

| Name of Dam | Catch. area (square miles) | Inglis floods 7000A $\sqrt{A+4}$ | Waste weir L×H | Disch. capacity _{1.5} 3.8 LH | Percentage of (5) over (3) |
|-------------------|-------------------------------|---|----------------------|---|----------------------------------|
| (1) | (2) | (3) | (4) | (5) | (6) |
| 1. Neyyar | 55 | 50,000 | 114'×17' | 30,400 | 60% |
| 2. Chemmani Pushi | 0.35 | 1,170 | 24'×2.5' | 360 | 30% |
| 3. Pulikannur .. | 0.325 | 1,090 | 24'×2.5' | 360 | 34% |

The provisions in the three cases are only 60, 30 and 34 per cent respectively of the Inglis* flood for the respective catchments. Under provision of spillway capacities is noticed in Mysore,

*Actually in Madras State the Ryve's formula (also followed in Kerala) ($Q=675A^{\frac{2}{3}}$) was evolved. But as it was found that this formula fell too short of actual floods since a co-efficient as high as 2700 has been observed in Madras State (vide page 33 of "Estimation of Design Flood" issued by C. W. & P. C.) for the sake of comparison here the Inglis formula has been adopted.

Madras, Andhra Pradesh and Kerala. Therefore, the Team reiterates its recommendations already made in its reports on the first three States, namely, review of the spillway design practices so as to provide adequate spillway capacities computed from detailed storm studies, adopting unit Hydrograph method;

- (b) Secondly, in the case of projects (2) and (3) above, which are earthen Dams, the U/S slopes provided in the original designs are as steep as $1\frac{1}{2} : 1$, the D/S ones being $2 : 1$ and $2\frac{1}{2} : 1$ — a phenomenon noticed in the case of tanks in Mysore, Madras and Andhra States also. The Team has to reiterate the recommendation already made in its Reports on these States, namely, the U/S slope should not be steeper than $2 : 1$. For dam of heights greater than 20 feet or so, the slopes may be based on detailed slip circle studies for sudden draw-down under saturated conditions. Also the D/S slopes could be limited to $1\frac{1}{2} : 1$ for heights up to 20 feet or so, as the D/S could be kept dry by providing bed drains. It may be mentioned that the State has already introduced such changes wherever possible; and
- (c) In the case of both the earthen dams mentioned above, it is noticed that the canal take-off level is at the bed-level of the reservoir, thus leaving no silting capacity in the reservoirs. It is recommended that in the case of small tanks at least about 20 per cent of the total capacity be reserved for silting, above these storage levels the canal should take off.



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CHAPTER V

SELECTION, EXECUTION AND MAINTENANCE OF MINOR IRRIGATION WORKS

The procedure followed with regard to selection of Minor Irrigation projects for execution is in accordance with the general pattern followed throughout the country. The projects are initially proposed by the local people either to the Block Development Officers in the Block areas, or to the District Development Councils in the non-Block areas. Thereafter, the Technical Officers attached to the Blocks in the Block areas or the P.W.D. in the non-Block areas carry out the necessary investigations to ascertain the feasibility or otherwise. The priority of feasible schemes is ultimately fixed by the Block Development Officers or the District Development Councils as the case may be.

2. The financial yardstick followed till recently was reported to be Rs. 250 per acre for flow and lift schemes. But, as it was not possible to carry out the flow schemes within this limit the same is now fixed at Rs. 400 per acre. It is understood that the present limits also are restrictive and they need upward revision both with regard to flow as well as lift schemes, as more promising sites are first exhausted and the remaining ones would be more and more difficult. The proposals for Third Five Year Plan provide for Rs. 500 per acre for works irrigating more than 200 acres and Rs. 400 for those irrigating less than 200 acres.

3. The execution of Minor Irrigation works is also being carried out so as to ensure full participation of the local people. The order of priorities according to which the execution of the works is to be entrusted to different agencies is as under :—

- (a) Village Panchayats;
- (b) Beneficiaries Co-operatives; and/or
- (c) Labour Societies.

4. The old existing irrigation works which are mostly concentrated in Travancore region are classified as (i) petty works (irrigating less than 5 acres) and (ii) medium works (irrigating more than 5 acres). The former are maintained by the people themselves and the latter by the P.W.D. The practice in (old) Madras State to which the Malabar area once belonged was to leave to the people the maintenance of works irrigating less than 200 acres, the rest being with P.W.D. However, now that the Panchayat Raj has been established in the State in pursuance of the accepted policy of Democratic Decentralisation, the general practice intended to be followed throughout the State is to (a) entrust Panchayats with the responsibility of maintaining the minor works benefiting less than 200 acres and (b) retain maintenance of works benefiting more than 200 acres with P.W.D. The Team considers this a step in the right direction. However, in order that routine maintenance and special repairs are carried out promptly and adequately, it has to be ensured that :—

- (a) the authorities in charge of maintenance should levy suitable annual acreage charges to finance the maintenance and repairs costs; and

(b) each Panchayat should employ necessary Technical staff in addition to routine maintenance staff.

5. As delays are noticed in land acquisition for the irrigation projects, the Team suggests taking necessary measures to expedite the acquisition of lands.

6. Investigations, planning and execution of important minor irrigation works and all major irrigation works in the State is entrusted to Special Chief Engineer, with 3 circles under him. This has resulted in a systematic planning and quick progress of works.



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CHAPTER VI

IRRIGATION ADMINISTRATION AND CESS

The rules regarding irrigation Administration and Cess are according to the "Travancore-Cochin Irrigation Act, 1956" so far as Travancore-Cochin Region is concerned and the "Madras Irrigation Act—1917", so far as Malabar Region is concerned. The Travancore-Cochin Irrigation Act, 1956, provides for Betterment Cess also, in addition to Irrigation Cess etc., whereas the Malabar Region is subjected to the Act No. III of 1955 of Madras State for the levy of Betterment (Appendix XV to Team's Report on Minor Irrigation Works in Madras State).

2. In 1958, the "Kerala Irrigation Bill" was drafted which was meant to supersede all the different Irrigation and Betterment Acts in the two regions of the State. This Bill was referred to a Select Committee for necessary amendments and they submitted a modified Bill. No Act is passed till now.

3. The extracts giving the water rates provided in the various Acts applying to the two Regions of the State viz. (i) Madras Irrigation Act, (ii) Travancore Irrigation Act as also (iii) the Kerala Irrigation Bill and (iv) Amended Kerala Irrigation Bill appear at Appendices II-A to D. The rates for most important crops according to these are as tabulated in the Statement at page 21, from which it is seen that the highest rate for second crop paddy is Rupees six to ten in the case of Travancore Cochin Act. The rate as proposed in the Kerala Irrigation Bill for this crop is only Rupees five, which was sought to be further reduced to Rupees four in the amended Bill. In fact the water rates both in (old) Madras and Travancore-Cochin were too low. The Kerala Irrigation Bill sought to follow practically the rates in vogue in Travancore-Cochin Act. The final Bill as amended by the Select Committee sought to provide for water rates even lower than those which were already there in Travancore-Cochin.

4. The approximate annual liabilities to the Government on account of the Minor Irrigation Schemes are roughly as under :—

| Sl. No. | Scheme | Investment per | | Annual Liability | |
|---------|--------------|----------------|------------------|-------------------------------------|---------------------|
| | | Net acres Rs. | cropped acre/Rs. | as percentage of capital Investment | as per cropped acre |
| 1. | Flow Schemes | 500 | 250 | 6% | 15 |
| 2. | Lift Schemes | 250 | 125 | 25% | 31 |

Therefore, it is seen that there is a vast scope for upward revision of water rates so as to avoid loss to Government. Since irrigation water is to be used for costly crops like paddy such upward revision is feasible even if only the paying capacity of the cultivators is to be considered. The Team has, therefore, to recommend that the water rates for different crops should be determined as indicated in Chapter VII of Vol. III of Taxation Enquiry Committee's Report (Appendix III).

| Sl. No. | Act or Bill | Government Life | | | | | | | | | |
|---------|---|--------------------------|---------------------------------|-------------------------------------|--|------------|-------------|------------|------------------|------------------|-----------|
| | | Land with one paddy crop | Land with 2 or more paddy crops | Land with garden crops Rs. As. etc. | Land with crops needing water for more than six months | First crop | Second crop | Third crop | First and Second | Second and Third | All three |
| 1 | Madras Irrigation Act, 1917 .. | 3-00 to 4-00 | 1-50 to 2-00 | 4-50 to 6-00 | 4-50 to 6-00 | — | — | — | — | — | — |
| 2. | Travancore-Cochin Irrigation Act, 1955 .. | 5-00 to 6-00 | 6-00 to 10-00 | Upto 10-00 | 10-00 | — | — | — | — | — | — |
| 3. | Kerala Irrigation Bill, 1958 | 3-00 | 5-00 | 5-00 | 5-00 | 5-00 | 10-00 | 15-00 | — | — | 25-00 |
| 4. | Kerala Irrigation Bill amended by Select Committee .. | 2-00 | 4-00 | 4-00 | 4-00 | 5-00 | 10-00 | 15-00 | 12-50 | 20-00 | 25-00 |

5. In respect of Lift Schemes, the Team notes that the paddy crop may not stand the full water rates as may have to be fixed so as to meet all the liability to Government. However, the ayacuts under such lifts located in the mid-lands of Kerala are well drained by the rivers which cut deep into the ayacut. Hence they are eminently suited for raising cash-crops like sugarcane. Also, in the moist torrid climate of Kerala, the yields of this crop would be high and would be able to pay the full water rates. Therefore, the Team strongly recommends utilising the lift waters for growing sugar-cane so as to make the schemes remunerative.

6. It is understood that the State Authorities would be interested in growing only paddy even on lifts so as to make up for the deficit and avoid purchase of costly paddy from other States. However, the Team is not convinced about the soundness of this policy and suggests a thorough review of the comparative economics of the two alternatives of utilising the lift waters (Chapter II).

7. There is a possibility of effecting considerable economy in running costs of lifts, if they are managed by the cultivators due to the flexibility in utilising the plant and personnel for alternative purposes when feasible. Also, they may have the benefit of volunteers or part-time workers. Therefore, the Team recommends encouraging co-operative ownership and management of lifts, in which case Government may help by way of Technical guidance and financial help through loans in proportion to the anticipated incremental capacity to repay as a result of irrigation.

8. It was mentioned at para (1) that Betterment Levy was prescribed under Madras and Travancore-Cochin Acts of 1955. But detailed rules thereunder are not framed and the provisions under the Act remain to be implemented. Therefore, the Team recommends that (a) a new Irrigation Act may be forthwith legislated providing proper Water rates and Betterment Levy and (b) steps taken to implement the same with speed.

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29th July, 1960.

A. N. KHOSLA.
Leader

SUMMARY OF RECOMMENDATIONS

Experiments should be conducted on underground filter-taps as an alternative to spring tanks in the case of future works, as also to supplement supplies to existing tanks, so as to :—

- (i) avoid wastage of land;
 - (ii) reduce evaporation losses; and
 - (iii) avoid contamination of drinking water, etc.
2. Some storages should be provided to stabilise water supplies on diversion schemes. This will increase their scopes considerably.
3. Steel gates and structures required for irrigation projects may be fabricated in local workshops as far as possible, in preference to ordering the same on Tungabhadra Workshops etc. in order to avoid delay.
4. In view of their established utility, schemes such as Lift Irrigation, Salt Water Barriers and Punja De-watering, may be taken up in increasing numbers.
5. *Design practices of earthen bunds and waste-weirs may be reviewed so that adequate spillway capacity is provided and the bund slopes are not too steep on the water side. Also, necessity of providing adequate silting capacity in the reservoirs is emphasised.
6. Use of hume-pipe conduits or overhead flumes supported on trestles, is recommended on lift irrigation schemes wherever economical in place of surface channels in cuttings or embankment so as to :—
- (a) avoid acquisition of land from unwilling people; and
 - (b) reduce percolation losses.
7. The proposal to entrust the maintenance of tanks irrigating less than 200 acres to the Panchayats is commendable. These Panchayats may also be authorised to levy suitable cess to finance the maintenance and repairs costs. Further, each Panchayat may employ necessary technical staff in addition to routine maintenance staff.
8. The water rates for all the crops are very low both in Travancore-Cochin and Malabar regions and need upward revision in accordance with the recommendations contained in the Taxation Enquiry Committee's Report.
9. As the liabilities on lift schemes cannot be met fully by paddy crops, lift waters may be utilised for growing cash and perennial crops like sugarcane. Also, so as to minimise the operational costs of lift and encourage

*Please also refer the recommendations of the Minor Irrigation Team contained in the Reports on Minor Irrigation Works in Mysore, Madras and Andhra Pradesh.

economic use of water, co-operative management of the lift schemes may be introduced. Government may offer financial and technical assistance to such co-operatives.

10. Speedy legislation of a new Irrigation Act providing for proper Water Rates for different crops and Betterment Levy and speedy implementation of the same, may be considered by the State Authorities.



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APPENDICES

- I Rivers of Kerala and their Yields.
- II A—Water Rates as per Madras Irrigation Act (1917).
B—Water Rates as per Travancore-Cochin Irrigation Act (1956).
C—Water Rates as per Kerala Irrigation Bill (1958)
D—Water Rates as per Kerala Irrigation Bill (1958)—(As amended by Select Committee)
- III Extract from Taxation Enquiry Commission's Report—1953-54—Volume III.
- IV Terms of Reference—Minor Irrigation Team.
- V Statement showing Observations and Recommendations of the Minor Irrigation Team along with the Comments of the Govt. of Kerala and Ministry of Food and Agriculture, Government of India.



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APPENDIX I

Annual Average Yields of Rivers in Kerala State

| Sl. No. | Name of River Basin | Length in Miles | Catchment area in square miles | Run off in T.M.C.Ft. |
|--------------------------|-----------------------|-----------------|--------------------------------|----------------------|
| (1) | (2) | (3) | (4) | (5) |
| I. WEST FLOWING RIVERS : | | | | |
| 1. | Manjeshwa | 10 | 14 | 3.0 |
| 2. | Uppala | 31 | 39 | 8.4 |
| 3. | Shiriya | 38 | 88 | 17.4 |
| 4. | Kumbla | 6½ | 10 | 2.1 |
| 5. | Mogral | 21 | 47 | 9.2 |
| 6. | Chandragiri | 65 | 234 | 52.8 |
| 7. | Kalnad | 5 | 6 | 1.3 |
| 8. | Bekal | 6½ | 10.5 | 2.0 |
| 9. | Chittari | 15½ | 31 | 7.0 |
| 10. | Nilashwar | 29 | 74 | 16.5 |
| 11. | Karingote | 40 | 184 | 40.1 |
| 12. | Kavvayi | 14 | 32 | 6.9 |
| 13. | Peruvamba | 25 | 110 | 23.6 |
| 14. | Ramapuram | 12 | 13 | 2.8 |
| 15. | Kuppam | 44 | 180 | 38.9 |
| 16. | Valapattanam | 70 | 256 | 54.4 |
| 17. | Anjarakandi | 40 | 43.5 | 7.7 |
| 18. | Tellicheru | 18 | 24 | 4.8 |
| 19. | Mahe | 34 | 90 | 18.2 |
| 20. | Kuttiyadi | 46 | 166 | 47.0 |
| 21. | Korapuzha | 25 | 232 | 58.7 |
| 22. | Kallai | 14 | 37 | 7.2 |
| 23. | Chaliyar | 105 | 1085 | 160.3 |
| 24. | Kadalundi | 81 | 430 | 77.3 |
| 25. | Pooraparamba | 5 | 9 | 1.6 |
| 26. | Tirur | 30 | 55 | 9.5 |
| 27. | Bharathapuzha | 156 | 2100 | 221.5 |

APPENDIX 1 (concl.)

| (1) | (2) | (3) | (4) | (5) |
|---------------------------|----------------------|-----|------|--------|
| 28. | Keecheri | 27 | 98 | 16.0 |
| 29. | Karuvannur | 30 | 330 | 42.0 |
| 30. | Chalakudy | 90 | 536 | 75.9 |
| 31. | Periyar | 142 | 2040 | 428.0 |
| 32. | Muvattupuzha | 75 | 588 | 93.7 |
| 33. | Meenachil | 42 | 456 | 96.3 |
| 34. | Menimala | 57 | 310 | 72.7 |
| 35. | Pamba | 110 | 763 | 222.8 |
| 36. | Atchencoil | 80 | 446 | 76.0 |
| 37. | Kallada | 75 | 600 | 76.0 |
| 38. | Ithikara | 35 | 270 | 42.0 |
| 39. | Vamanapuram | 50 | 336 | 52.1 |
| 40. | Karamana | 42 | 250 | 38.8 |
| 41. | Neyyar | 35 | 191 | 29.6 |
| II. EAST FLOWING RIVERS : | | | | |
| 42. | Kabbani | — | 762 | 145.0 |
| 43. | Bhavani | — | 220 | 27.0 |
| 44. | Pambar | — | 148 | 24.0 |
| TOTAL | | | | 2460.0 |

APPENDIX II-A

The Malabar Irrigation Works (Construction and levy of cess) Act, 1917. Rules under the Act—Issued.

RULES

7. (I) Water cess to be levied under section 12 of any land in respect of which a permit for irrigation has been issued under the Set and is in force shall be in accordance with the conditions here-in-after mentioned and the rates specified below :—

| Description of Crop | | | Charges per acre | | | |
|---|--|--|---------------------|--|----------------------|--|
| | | | First class sources | | Second class sources | |
| | | | Rs. | | Rs. As. | |
| (a) Sugarcane, betel, plantain, turmeric and elephantayam .. | | | 6 | | 4 8 | |
| (b) Any other crop which required water for more than six months. | | | 6 | | 4 8 | |
| (c) Crops other than those specified in clauses (a) & (b) .. | | | | | | |

| Sl. No. | First crop | Second crop | First class sources | | | Second class sources | | | | |
|---------|------------|--------------------------------|---------------------|-------------|------------|----------------------|-------------|---------------|-----|-----|
| | | | First crop | Second crop | Total crop | First crop | Second crop | Total charges | | |
| (1) | (2) | (3) | (4) | | | (5) | | | | |
| | | | Rs. | As. | Rs. | As. | Rs. | As. | Rs. | As. |
| 1. | Wet | Wet | 4 | — | 2 | — | 6 | — | 3 | — |
| 2. | Do. | Dry, systematically irrigated. | 4 | — | 1 | 8 | 5 | 8 | 3 | — |
| 3. | Do. | Dry, occasionally irrigated. | 4 | — | 1 | — | 5 | — | 3 | — |
| 4. | Do. | Dry, systematically irrigated. | 3 | — | 2 | 8 | 5 | 8 | 2 | 4 |
| 5. | Do. | Dry, systematically irrigated. | 3 | — | 2 | — | 5 | — | 2 | 4 |
| 6. | Do. | Dry, occasionally irrigated. | 3 | — | 1 | 8 | 4 | 8 | 2 | 4 |
| 7. | Do. | Dry, occasionally irrigated. | 2 | — | 3 | — | 5 | — | 1 | 8 |
| 8. | Do. | Dry, systematically irrigated. | 2 | — | 2 | 8 | 4 | 8 | 1 | 8 |
| 9. | Do. | Dry, occasionally irrigated. | 2 | — | 2 | — | 4 | — | 1 | 8 |

APPENDIX II—A (concl'd.)

| | First class source | Second class source |
|--|--------------------|---------------------|
| Third Crop. | | |
| Wet | 2 0 | 1 8 |
| Dry, whether systematically irrigated or occasionally irrigated. | 1 0 | 0 12 |

APPENDIX II—B

**Extract of the Travancore-Cochin Irrigation Act, 1936
No. VII of 1936.**

3. In the case of lands benefited by a major irrigation work the construction, expansion or alteration of which the Government have undertaken on or after the 1st January, 1943, the cess leviable under sub-section (1) shall be at the following rates :—

- | | |
|---|---|
| (a) lands already registered as single crop wet lands and on which two or more paddy crops could be raised .. | Rs. 6 per acre. |
| (b) other lands already registered as wet lands | Rs. 5 per acre. |
| (c) lands made fit for cultivation and on which only one paddy crop could be raised | Rs. 6 per acre. |
| (d) lands made fit for cultivation and on which two or more paddy crops could be raised | Rs. 10 per acre. |
| (e) Other lands benefited | at such rates per acre not exceeding rupees ten as may be fixed by the Govt. from time to time. |

Provided that in cases where irrigation water is availed of by bailing or by means of mechanical contrivances, the water cess leviable shall be at 50 per cent of the rates specified in clause (a) or clause (b) or clause (c) or clause (d), as the case may be.

Explanation :—The right of the Government to levy cess at the rates specified in this sub-section shall not be affected by the fact that the lands are cultivated with crops other than paddy or that the lands are not actually cultivated.

APPENDIX II—C

The Kerala Irrigation Bill, 1958.

SCHEDULE

PART I

See sections 4(5) and 5(3) and (4)

Rates of cess on areas benefited by Petty and Minor Irrigation Works.

| <i>Category of land</i> | <i>Rate of cess</i> |
|---|---------------------|
| 1. Lands on which one paddy crop alone is raised | Rs. 3 per acre |
| 2. Lands on which two or more paddy crops are raised | Rs. 5 per acre |
| 3. Lands on which sugarcane, betel, plantain, turmeric or elephantayam is cultivated by use of the irrigation water | Rs. 5 per acre |
| 4. Lands on which any other crop which requires water for more than six months in a year is raised | Rs. 5 per acre. |

PART II

(See section 13)

Rates of cess on lands benefited by Major Irrigation works.

| <i>Category of land benefited</i> | <i>Rate of cess</i> |
|---|--|
| (a) Lands already registered as single crop wet lands and on which two or more paddy crops could be raised on account of the irrigation | Rs. 7.50 per acre. |
| (b) Other lands already registered as wet lands | Rs. 5.00 per acre. |
| (c) Lands made fit for cultivation and on which one paddy crop could be raised on account of irrigation | Rs. 7.50 per acre. |
| (d) Lands made fit for cultivation and on which two or more paddy crops could be raised on account of irrigation | Rs. 12.50 per acre. |
| (e) Other lands benefited | At such rates per acre not exceeding Rs. 10.00 as may be fixed by the Govt. from time to time. |

Provided that in cases where irrigation water is availed of by bailing or by means of mechanical contrivances the water cess leviable shall be at fifty per cent of the rate specified in clause (a) or clause (b) or clause (c) or clause (d) as the case may be,

Provided further that in cases where irrigation water is supplied from a major irrigation work by using lift pumps or other mechanical contrivances the water cess leviable shall be at fifty per cent of the rate specified in clause (a) or clause (b) or clause (c) or clause (d) as the case may be, plus the rate specified in Part IV of the Schedule :

APPENDIX II—C (concl'd.)

Provided also that in the case of lands falling under clause (c) and clause (d) the rates at which cess may be levied for the first three years after the lands have been made fit for cultivation shall be fifty per cent the rates specified in those clauses.

PART III

Rates of cess on areas benefited by lift Irrigation works undertaken by Local Authorities or Cultivators' Co-operative Societies.

| | Rate of cess |
|---------------------|------------------|
| First crop | Rs. 5 per acre. |
| Second crop | Rs. 15 per acre. |
| Third crop | Rs. 20 per acre. |

PART IV

Rates of cess on areas benefited by lift Irrigation works undertaken by the Government.

[See section 18(4)]

| | Rate of cess |
|---------------------|-----------------|
| First Crop | Rs. 5 per acre |
| Second crop | Rs. 10 per acre |
| Third crop | Rs. 15 per acre |

Provided that in cases where water has been supplied for three crops, the rate of cess shall be Rs. 25 per acre for all the three crops together.

APPENDIX II-D

Report of the Select Committee on the Kerala Irrigation Bill, 1958 and the
Bill as Reported by the Committee,

SCHEDULE

PART I

See sections 4(5) and 5(3) and (4)

*Rates of cess on areas benefited by Petty and Minor
Irrigation Works.*

| <i>Category of land</i> | <i>Rate of cess</i> |
|---|---------------------|
| 1. Lands on which one paddy crop alone is raised | Rs. 2 per acre |
| 2. Lands on which two or more paddy crops are raised | Rs. 4 per acre |
| 3. Lands on which sugarcane, betel, plantain, turmeric or elephant- yam is cultivated by use of the irrigation water | Rs. 4 per acre |
| 4. Lands on which any other crop which requires water for more than six months in a year is raised | Rs. 4 per acre. |

PART II

(See Section 13)

Rates of cess on lands benefited by Major Irrigation Works

| <i>Category of land benefited</i> | <i>Rate of cess</i> |
|---|---|
| (a) Lands already registered as single crop wet lands and on which two or more paddy crops could be raised on account of the irrigation | Rs. 6 per acre |
| (b) Other lands already registered as wet lands | Rs. 4.50 per acre |
| (c) Lands made fit for cultivation and on which one paddy crop could be raised on account of irrigation | Rs. 6 per acre |
| (d) Lands made fit for cultivation and on which two or more pad- dy crops could be raised on account of irrigation | Rs. 10 per acre |
| (e) Other lands benefited | At such rates per acre not exceeding Rs. 10 as may be fixed by the Govt. from time to time. |

Provided that in cases where irrigation water is availed of by bailing or by means of mechanical contrivances the water cess leviable shall be at fifty per cent of the rate specified in clause (a) or clause (b) or clause (c) or clause (d), as the case may be :

Provided further that in cases where irrigation water is supplied from a major irrigation work by using lift pumps or other mechanical contrivances the water cess leviable shall be at fifty per cent of the rate specified in clause

APPENDIX II-D (contd.)

(a) or clause (b) or clause (c) or clause (d), as the case may be, plus the rate at specified in Part IV of the Schedule :

Provided also that in the case of lands falling under clause (c) and clause (d) the rates at which cess may be levied for the first three years after the lands have been made fit for cultivation shall be fifty per cent of the rates specified in those clauses.

PART III

Maximum rates of cess on areas benefited by lift Irrigation Works undertaken by Local Authorities or Cultivators' Co-operative Societies.

[See sections 17(2) and 19(2)]

| | | | | | | | |
|-------------|----|----|----|----|----|----|-----------------|
| First Crop | .. | .. | .. | .. | .. | .. | Rs. 5 per acre |
| Second crop | .. | .. | .. | .. | .. | .. | Rs. 15 per acre |
| Third crop | .. | .. | .. | .. | .. | .. | Rs. 20 per acre |

PART IV

Rates of Cess on areas benefited by lift Irrigation Works undertaken by the Government.

See section 18(4)

| | | | | | | | Rate of cess |
|-------------|----|----|----|----|----|----|-----------------|
| First crop | .. | .. | .. | .. | .. | .. | Rs. 5 per acre |
| Second crop | .. | .. | .. | .. | .. | .. | Rs. 10 per acre |
| Third crop | .. | .. | .. | .. | .. | .. | Rs. 15 per acre |

Provided that

- (i) in cases where water has been supplied for three crops, the rate of cess shall be Rs. 25 per acre for all the three crops together;
- (ii) in cases where water has been supplied for the first and second crops, the rate of cess shall be Rs. 12.50 per acre for the two crops together;
- (iii) in cases where water has been supplied for the second and third crops, the rate of cess shall be Rs. 20 per acre for the two crops together.

V. KRISHNAMOORTHY,
Secretary,
Legislative Assembly.

APPENDIX III

Extract from Taxation Enquiry Commission's Report 1953-54— Volume III.

Character of the water rate :—It is very difficult to make any general statement whether the water rate is a service charge or includes an element of tax. In the case of more recent irrigation works, the water rates do not yield receipt even to cover the water service costs; but on some older works (e.g. in Hyderabad, Punjab and Uttar Pradesh) the Governments concerned realise some profits. In the case of irrigation works undertaken with a definite protective intent, there is a considerable element of subsidy from general revenues. The scale of water rates being largely dependent upon economic and other circumstances of the area commanded by the work, it takes the character of a service charge in some areas and of a tax in other areas. Broadly, the assessment of water rates may be regulated according to three different principles :

- (1) no loss and no profit;
- (2) no profit and some loss;
- (3) some profit and no loss.

No one principle can, however, be recommended for universal application. Ordinarily, water rates must cover the maintenance charges, i.e. the policy must be no profit but also no loss. But to this there would be several exceptions. A policy of no profit and some loss would in our opinion be justified in the case of an irrigation work for a scarcity area which is being economically developed. On the other hand, a policy of some profit and no loss would, we believe, be justified where an irrigation project has been provided for a fairly well-off area or where an old work existed from which benefit had already been derived and continues to be derived by cultivators in the region.

Water rates on different work :—Productive irrigation works, i.e. works in areas other than scarcity areas, should not, as a rule, involve any loss to the general revenues.

Voluntary water rate :—In determining the water rate that is payable by those who take water, the first principle would be as indicated earlier, that the realisations from such a rate should at least cover the debit charges and overhead expenses on the project. While this would be the basic principle, several other considerations enter into the fixation of water rates. The more important of these are :—

- (1) quantity of water supplied;
- (2) value of crop grown;
- (3) extent of benefit realised by the cultivator; and
- (4) ability of the cultivator to pay.

As observed by the U.P. Irrigation Rates Committee, 1938: "The value of water is a function of the cost of supply and the increase in produce value from the land irrigated. The former determines the lowest financially

sound, and the latter the uppermost permissible limit between which water rates can vary, and a fair rate is one which yields adequate profit on the outlay on the one hand and offers sufficient inducement to the cultivators, on the other, but prevents them from extravagance or waste"

Basis of water rates:—In any system of water rates, the upper limit is naturally set by considerations of capacity to pay, as reflected in the size of net income a cultivator is able to gather from his irrigated crop. But determination of net income presents many administrative difficulties, although on theoretical grounds the case for water rates being linked to net incomes is unassailable. The adoption of such a rate would involve classification of lands into various categories to correspond to various degrees of benefits conferred and also periodical valuation thereof. A water rate fixed on the rental basis, would also not be proper, as rental income is in several cases subject to other charges. A simpler method of fixing the water rates is to determine them on the basis of the value of the crop grown. The practice in other countries conforms to this principle. A water rate which varies with the value of the market price of crops is also more equitable than a flat water rate. Further, a water rate linked to the crop provides scope for variation in the charges according to the quantity of water drawn, since water requirements vary considerably for different crops. A charge dependent entirely upon the quantity of water drawn is more scientific and a large body of opinion is in favour of the adoption of the volumetric basis. Although, as discussed earlier, the system is theoretically ideal and is in operation in lift irrigation schemes, its extension to canal irrigated lands presents a number of practical difficulties. It is obvious that while fixing rates for supply of water for irrigation no single basis which would meet the different conditions and differing requirements of the various States can be devised.

Profit element in water rate:—The scope and justification for the inclusion of a tax or profit element in the water rate arises in areas where the alternative cost of supply is higher than the rate fixed by the Government or where the area covered by the work is fairly developed and the irrigation facilities add further to this development. Moreover, where because of the low cost of construction and maintenance of old irrigation works, water rates are much lower than in other areas and undue advantage from these low rates is derived by individual cultivators, the State Governments would be justified in increasing the water rates by adding an element of tax with a view to appropriate to the general revenues some part of these large benefits that have accrued. Normally, however, the possibility of State Governments earning profits from water rates is limited, being confined practically to the older works, as in most of the recent projects the costs of maintenance are so great that no margin is left for earning profits from water rates.

APPENDIX IV

NO. COPP/(4)/17/58

Reserve Bank Building
Parliament Street,
New Delhi, August 4, 1958.

The Chief Secretary,

Government of Madras, Madras/Andhra Pradesh, Hyderabad/
Mysore, Bangalore/Kerala, Trivandrum/Punjab, Chandigarh/
Uttar Pradesh, Lucknow.

SUBJECT :—*Team for the study of Minor Irrigation Project.*

Sir,

I am directed to forward a copy of the Terms of Reference of the Minor Irrigation Team set up by the Committee on Plan Projects. The Team will conduct studies in accordance with these Terms of Reference in your State.* In order to enable the Secretary of the Team to get in touch with the relevant authorities in the State, it is suggested that a liaison officer may be appointed for this purpose with whom he could maintain contact for such arrangements and facilities as may be necessary for this study.

2. The composition of the Team will be as follows :—

- | | |
|---|--------------------------|
| 1. Shri N. V. Gadgil | Leader |
| 2. Shri M. Narasimhaiya | Member |
| 3. Shri Lal Singh | Member |
| 4. Irrigation Adviser to the Government of India | Member <i>ex-officio</i> |
| 5. Shri D. S. Borker | Secretary |

3. The Team has been instructed to associate the local officers with its work. The Leader of the Team will contact the State Government for the name of the official or officials who should be associated with the Team.

Yours faithfully,

INDARJIT SINGH

*Joint Secretary, Finance
and Secretary, COPP.*

Terms of Reference of the Minor Irrigation Team.

The minor irrigation projects may be divided for study into two parts :—

- (a) Works already in existence.
- (b) Works which are now being constructed.

*For U.P. and Punjab only.

APPENDIX IV (contd.)

2. Case studies should be made of a number of projects of each type under the above headings with a view to judging their efficiency having regard to the objectives with which such works were carried out.

3. The following points should be especially borne in mind :—

Existing Projects :

- (i) The present state of repair and maintenance.
- (ii) The system of keeping works in proper maintenance with particular reference to the customary obligations of villagers for keeping such works in a sound condition from year to year, the team should also examine the extent to which these obligations are enforced, the reasons for the failure to do so and the steps that should be taken to carry out such obligations efficiently.
- (iii) Reasons, if any for non-utilisation of water by cultivators.
- (iv) Improvements necessary to make the projects more efficient either in the matter of better agricultural planning and practices or in respect of engineering works.
- (v) Cost of restoration if the project is in a state of disrepair and whether it has been included in the Plan.

New Projects :

- (i) Method of selection—procedure and principles on which priorities are based.
- (ii) Flow Chart of the construction Project should be prepared to examine whether any avoidable delay has occurred in its completion.
- (iii) Whether fullest use is made of catchment capacity in preparing designs.
- (iv) Economics of design.
- (v) State of agricultural planning with a view to optimum utilisation of benefits.
- (vi) Institutional arrangements provided for the proper maintenance of new works with special reference to the customary obligation of villagers in this regard.
- (vii) Cost of actual construction compared to estimated costs—the reasons for increase if any and the care with which the initial estimates were framed.

4. Any other matter which the Team considers necessary to report upon having a bearing on economy and efficiency of such projects.

5. The following information should be gathered by the Team for each State, taken as a whole in regard to existing minor irrigation works :—

- (i) The total area irrigated from them according to Settlement registers.
- (ii) The area actually irrigated from year to year beginning from 1947.
- (iii) The reason for the reduction, if any, in the area irrigated.

APPENDIX IV (concl.)

6. In addition, the Team will carry out a study of the tubewell schemes of the Punjab and the U.P. with reference to the fact whether optimum use has been made of the facilities available by ensuring scientific crop planning and by improving agricultural practices. The study should be based on an examination of individual tubewells, which may be divided into most successful, successful and least successful varieties for the purpose of study. The Team should also select a few tubewells for which alternative crop planning and practices may be recommended that are being carried out at present in order to make them more successful. The consideration mentioned regarding minor irrigation works in paragraph 3 *mutatis mutandis* be taken into consideration for the study of tubewells also.



सत्यमेव जयते

APPENDIX V

Statement showing Observations and Recommendations of the Minor Irrigation Team along with the Comments of the Government of Kerala and Ministry of Food and Agriculture, Government of India.

| Para-graph No. of the Summary | Summary of the Recommendations and Observations of the Team | Comments of the Government of Kerala |
|-------------------------------|---|--------------------------------------|
| (1) | (2) | (3) |
| 1. | Experiments should be conducted on under ground filter-taps as an alternative to spring tanks in the case of future works as also to supplement supplies to existing tanks so as to :— (i) avoid wastage of land; (ii) reduce evaporation losses: and (iii) avoid contamination of drinking water etc. | Noted. |
| 2. | Some storages should be provided to stabilise water supplies on diversion schemes. This will increase their scopes considerably. | Noted. |
| 3. | Steel gates and structures required for irrigation projects may be fabricated in local workshops as far as possible, in preference to ordering the same on Tungabhadra Workshops etc., in order to avoid delay. | Noted. |
| 4. | In view of their established utility schemes, such as Lift Irrigation, Salt Water Barriers and Punja De-watering may be taken up in increasing numbers. | Noted. |
| 5. | Design practices of earthen bunds and waste-weirs may be reviewed so that adequate spillway capacity is provided and the bund slopes are not too steep on the water side. Also, necessity of providing adequate silting capacity in the reservoirs is emphasised. | Noted. |
| 6. | Use of hume-pipe conduits or overhead flumes supported on trestles is recommended on lift irrigation schemes where ever economical in place of surface channels in cuttings or embankment so as to : (a) avoid acquisition of land from unwilling people; and (b) reduce percolation losses. | Noted. |

APPENDIX V (contd.)

| (1) | (2) | (3) |
|-----|--|---|
| 7. | The proposal to entrust the maintenance of tanks irrigating less than 200 acres to the Panchayats is commendable. These Panchayats may also be authorised to levy suitable cess to finance the maintenance and repair costs. Further, each Panchayat may employ necessary technical staff in addition to routine maintenance staff. | Noted. The financial position of the Panchayats do not make it possible for employment of technical personnel in each Panchayat. |
| 8. | The water rates for all the crops are very low both in Travancore-Cochin and Malabar regions and need upward revision in accordance with the recommendation contained in the Taxation Enquiry Commission's Report. | This is being gone into. |
| 9. | As the liabilities on lift schemes cannot be met fully by paddy crops, lift waters may be utilised for growing cash and perennial crops like sugarcane. Also, so as to minimise the operational costs of lift and encourage economic use of water, co-operative management of the lift schemes may be introduced. Government may offer financial and technical assistance to such co-operatives. | Noted. So far as existing rice fields are concerned switching over to cash crops will increase the gap between production and demand of rice. |
| 10. | Speedy legislation of a new Irrigation Act providing for proper Water Rates for different crops and Betterment levy and speedy implementation of the same, may be considered by the State Authorities. | Noted. |



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APPENDIX V (concl'd.)

KRISHAN CHAND, ICS.,
Joint Secretary

D.O.No.IA-PA/60
Government of India,
Ministry of Food & Agriculture,
(Department of Agriculture)
New Delhi.
September 8, 1960.

My dear Borker,

Please refer to your D.O. letter No. COPP/I&P/9/60/1551, dated 28th August, 1960, addressed to Shri Damle. Thank you very much indeed for forwarding a copy of the draft report on Minor Irrigation Works in Kerala. We have gone through the report and appreciate the detailed examination which has been made. We agree with the recommendations.

Yours faithfully,
KRISHAN CHAND

Shri D.S. Borker,
Secretary, Consultative Committee,
Irrigation and Power Projects,
Committee on Plan Projects,
Yojana Bhavan,
NEW DELHI.



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